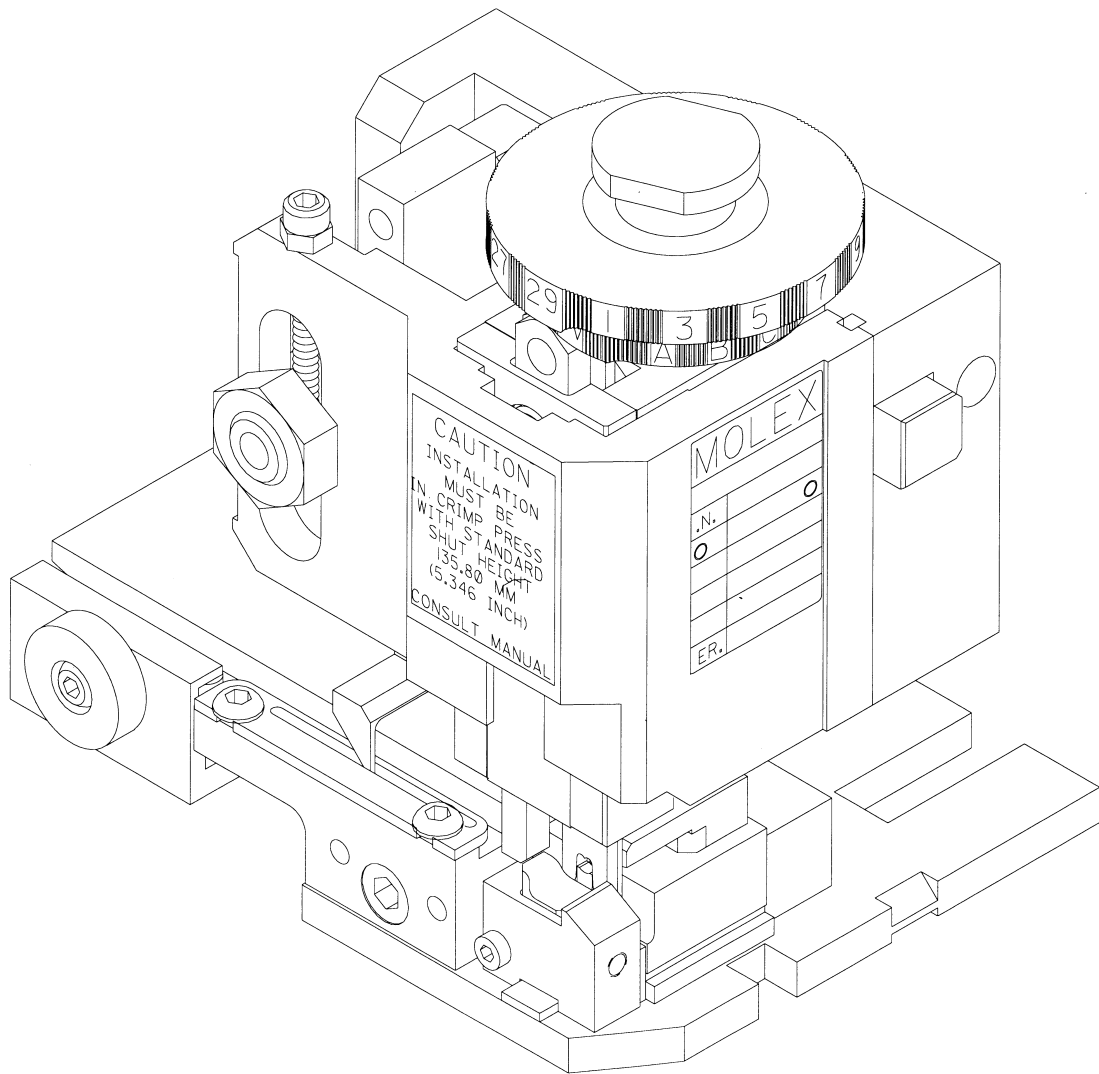




FineAdjust Applicator Instruction Manual



- **DESCRIPTION**
- **OPERATION**
- **MAINTENANCE**

WARNING

- NEVER** USE THIS APPLICATOR IN A PRESS OR WIRE PROCESSING MACHINE WITHOUT GUARDS OR SAFETY DEVICES THAT ARE INTENDED TO PREVENT HANDS FROM REMAINING IN THE DIE SPACE. THIS APPLICATOR IS SUPPLIED WITH NO GUARDS AND IS INTENDED TO BE USED WITH THE GUARDS SUPPLIED BY THE PRESS AND/OR WIRE PROCESSING MANUFACTURER.
- NEVER** OPERATE, SERVICE, INSTALL OR ADJUST THIS APPLICATOR, WITHOUT PROPER INSTRUCTION AND WITHOUT FIRST READING AND UNDERSTANDING THE INSTRUCTIONS IN THIS MANUAL AND ALL APPLICABLE PRESS AND/OR WIRE PROCESSING MACHINE MANUALS.
- NEVER** INSTALL OR SERVICE THIS APPLICATOR WITH ANY ELECTRICAL OR PNEUMATIC POWER SOURCE CONNECTED TO THE PRESS.
- CAUTION** THE MOLEX FINEADJUST APPLICATORS ARE DESIGNED TO OPERATE IN CRIMP PRESSES WITH STANDARD SHUT HEIGHTS OF 135.80MM (5.346"). INSTALLATION IN CRIMP PRESSES WITH OTHER THAN STANDARD SHUT HEIGHTS CAN CAUSE SEVERE TOOL BREAKAGE. IT IS ADVISABLE THAT BEFORE INSTALLATION, A CHECK OF THE SHUT HEIGHT BE PERFORMED. MOLEX WILL NOT BE LIABLE FOR ANY DAMAGES AS A RESULT OF INSTALLATION IN CRIMP PRESS WITH NON-STANDARD OR IMPROPERLY SET SHUT HEIGHTS.

WORK SAFELY AT ALL TIMES

**FOR SERVICE CONTACT YOUR
LOCAL MOLEX SALES OFFICE**

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FineAdjust Applicator

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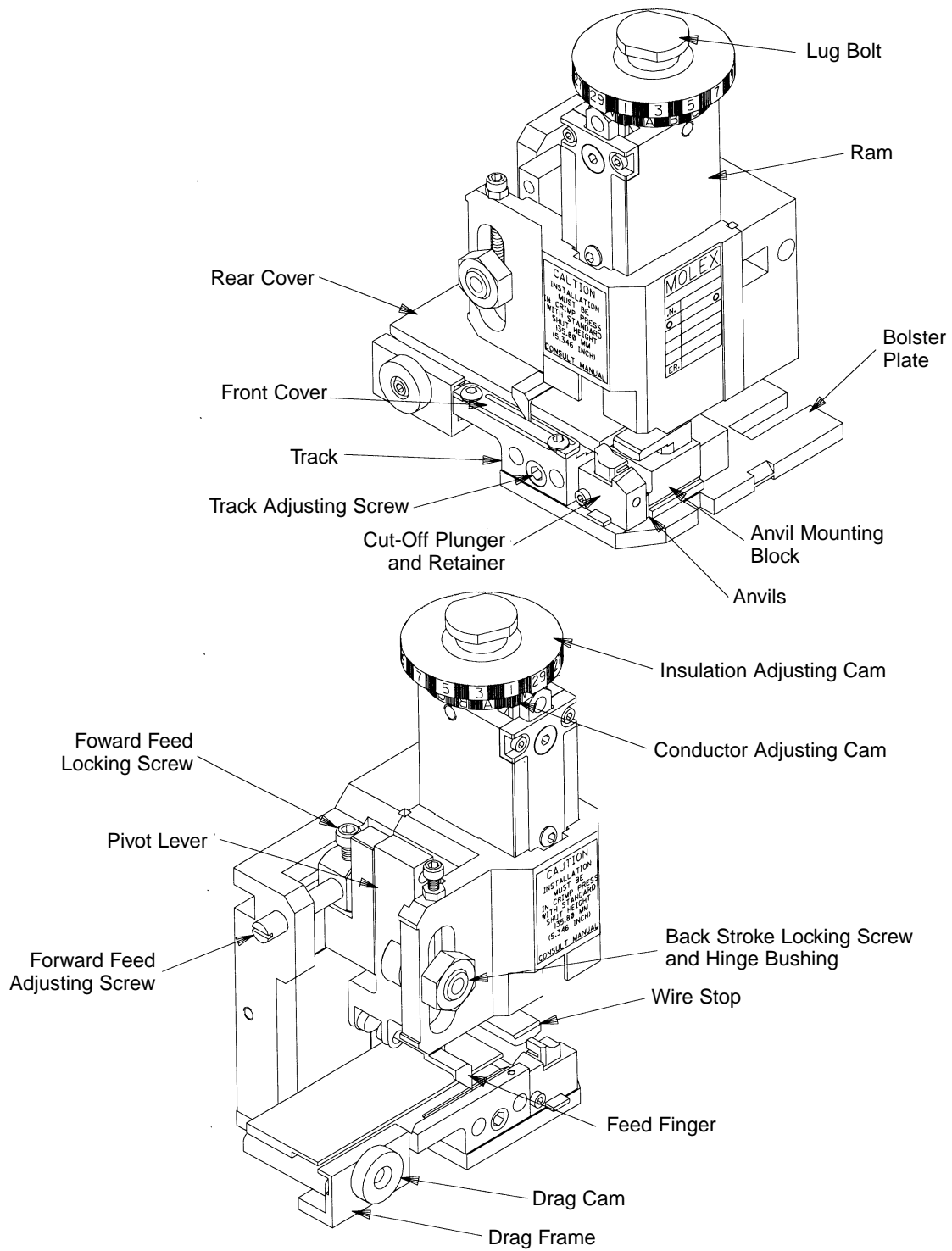
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Chapter 1

Description

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Principal Mechanical Parts of the FineAdjust Applicator



1.1 General Description

1.1.1 Description

The Molex FineAdjust applicator is the most advanced version of the universal crimping tool available. It's designed to allow for quick in press adjustments of crimp heights, maintaining statistical control at, or near mean, even after wire change over.

Molex's FineAdjust applicator offers minimal set up time, and easy maintenance for increased cost savings, while delivering many standard features. Crimp heights can be preset for fast setup, with optimum adjustments being made while the applicator is in the press without any shimming. Crimp height process control that is maintained across a full range of wire types and insulation diameters for superior quality.

Molex offers the following crimp presses for operating the FineAdjust Applicator.

- TM7-MM Press (Order No. 11-05-0043) in North America
- TM44 Press (Order No. 11-09-2074)
- TM144SC Press and Stripping Unit (consult factory)

The FineAdjust Applicator is also compatible with most OEM presses (Artos, Mecal, Megomat, Toyojamco, etc). It also adapts to wire processing machines (Artos, Komax, Megomat, Toyojamco, etc).

1.1.2 Features

- Independent conductor adjustments in 0.015mm (0.0006") increments, and insulation adjustments in 0.063mm (0.0025") increments to meet the most critical requirements
- Adjustment of the track position while the applicator is in the press, delivering easy control of the bellmouth size, and tab cut-off length
- Crimp punches & anvils provide quick-change capabilities for different wire diameter ranges
- No shimming required
- Enhanced crimping productivity

- Standardized tooling for customers using the Molex TM42 press and terminator
- Mechanical terminal feed
- Applicator designed to industry standard mounting and shut height (135.8mm (5.346"))
- Adjustable terminal feed with applicator in press
- Positive stop for wire positioning (Bench Press)
- Terminals are separated from carrier strip automatically during crimping operation
- Quiet operation with low maintenance
- Easy to keep clean
- Low setup and down time
- Can be used on either bench or wire processing machines

1.2 Technical Specification

1.2.1 Dimensions

Width - 132mm (5.2")
Depth - 101mm (4.0")
Height - 152mm (6.0")

1.2.2 Weight

4.1kg (9lbs)

1.2.3 Press Stroke Compatibility

41.28mm (1 5/8")
28.58mm (1 1/8")

1.2.4 Guarding

The FineAdjust is supplied with no guards and is designed to be used with the guards supplied from the press manufacturer.

CAUTION:

DO NOT use the applicator without guards in place

1.3 Delivery Check

The following items are included in the FineAdjust Applicator package:

Description	Qty
FineAdjust Applicator (Tooled for desired terminal)	1
Short Feed Cam (Order No. 11-18-4238)	1
Sample Crimped Terminals	5
Manual (Order No. 63800-0360)	1
Setup & Specification Documents	1
Track Adjustment Tool (Order No. 63800-0361)	1

1.4 Crimp Tooling Accessories

The following accessories for use in a crimping operation are available from Molex. Contact your local Molex Sales Engineer for additional information.

1.4.1 Shut Height Gauge

Order No.: 11-14-5024

1.4.2 Terminal Oiler

Order No.: 11-40-0237

1.4.3 Terminal Oil (1 gallon)

Order No.: 11-14-5027

1.4.4 Digital Crimp Micrometer

Order No.: 63800-2800

1.4.5 Interleaf Paper Take-Up

Order No.: 11-14-5023

1.4.6 Carrier Strip Cutter

Order No.: 11-14-5022

1.4.7 Crimp Process Monitor

Order No.: consult factory

Chapter 2

Operation

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2.1 Shut Height

The Molex FineAdjust Applicators are designed to operate in crimp presses with standard shut height of 135.80mm (5.346"). Installation in crimp presses with other than standard shut heights can cause severe tool breakage. It is advised that before installation, a check of the shut height be performed. The correct shut height is required to prevent the punches from hitting the anvils and the cut-off tooling from bottoming out on the bolster plate. It also allows the movement of applicators from press to similar press without making adjustments to the applicator or press shut height.

The shut height of the press can be adjusted with a shut height gauge, which is calibrated under load to achieve the 135.80mm (5.346") measurement. It is recommended that the shut height be checked monthly. A shut height gage is available from Molex (Order No. 11-14-5024). Please consult your sales representative for pricing and availability.

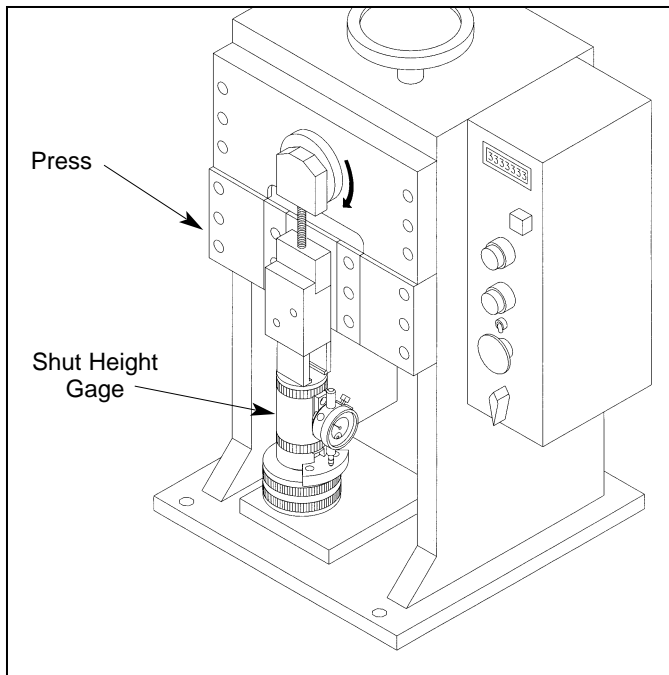


Figure 2.1 Shut Height

2.1.1 Measuring Press Shut Height

- 2.1.1.1 Turn off and disconnect power from the press. Remove the machine guards if necessary.
- 2.1.1.2 Remove the applicator from the press. (Refer to section 2.2.1 Applicator Installation & Removal) See that the bottom of the press ram and bolster plate are free from foreign material.

- 2.1.1.3 Place the shut height gauge into the press on the press base plate. Refer to Fig. 2.1)
- 2.1.1.4 Manually cycle the press to the downstroke position. Refer to the press manufacturer for manually cycling of the press.
- 2.1.1.5 Read the shut height measurement from the front of the gauge.
- 2.1.1.6 If adjustments are necessary, refer to the press manufacturer for adjustment of the press shut height.
- 2.1.1.7 Repeat the above steps until the correct shut height is obtained.

2.2 Setting-Up

The principal mechanical parts of the FineAdjust are illustrated in Section 3.3 Assembly Drawings.

2.2.1 Applicator Installation & Removal

All presses must be equipped with a common universal type quick-change base plate and adapter on the press. Contact the press manufacturer for specific information.

- 2.2.1.1 Always turn off and disconnect power to the press. Remove the press guards.
- 2.2.1.2 Slide the FineAdjust onto the base plate until the two notches on the left side engage against the stops and at the same time enter the lug bolt into the adapter on the press. (Refer to Fig. 2.2.2 Fitting Terminal Strip)
- 2.2.1.3 Some presses have locking latches on the base plate which have to be flipped up for securing the applicator, others have knurled finger screws or some have "T" type latches. Most are located on the right side of the base plate for tight positioning of the applicator. These must be in place and secured before operating press. (Refer to Fig. 2.2.1.3 Press Base Plate Locking Latch)

2.2.1.4 Remove the applicator by reversing the foregoing steps. When storing an applicator always leave a strip of terminals in the applicator to prevent damage to the tooling. (Refer to Section 3.1.1 Storage)

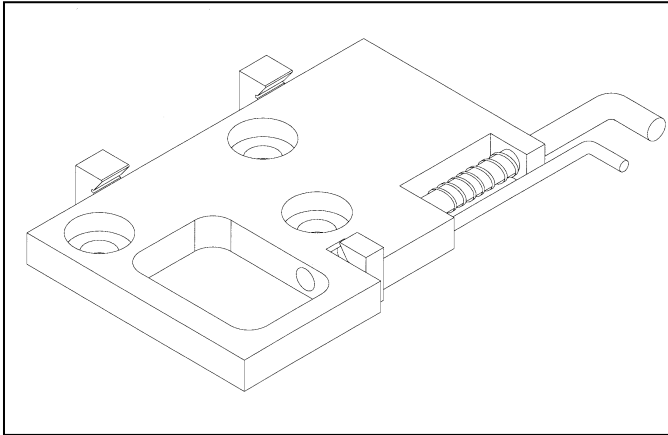


Figure 2.2.1.3 Press Base Plate Locking Latch - Molex TM7 Press

2.2.2 Fitting Terminal Strip

- 2.2.2.1 The specified terminal is printed on the setup sheet for the applicator. Only use Molex terminals, as indicated on the set up sheet supplied, with the applicator.
- 2.2.2.2 Turn off and disconnect power from the press. Remove the machine guards if necessary.
- 2.2.2.3 Rotate the drag cam until the drag frame is fully raised. This will allow the terminal to slide with ease through the applicator track. (Refer to Fig. 2.2.2 Fitting Terminal Strip)
- 2.2.2.4 Push the terminal strip until the first terminal comes to rest centered above the anvil.
- 2.2.2.5 Rotate the drag cam to engage the terminal drag frame.

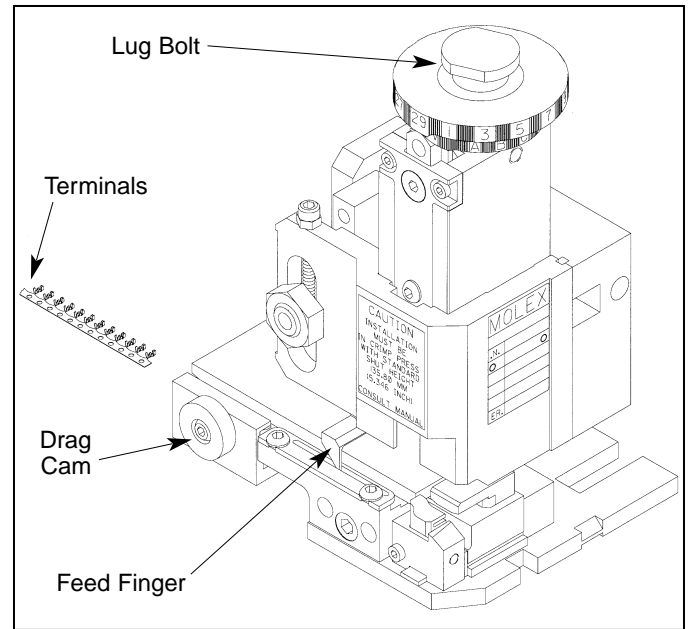


Figure 2.2.2 Fitting Terminal Strip

- 2.2.2.6 Cycle the press by hand to be certain that the feed finger transfers the next terminal to a centered position over the anvil. Check that all other parts slide and engage without any interference. It is advisable to go through this procedure several times.
- 2.2.2.7 When unloading the terminal strip make sure power is turned off and disconnected from the press. Remove the machine guards if necessary.
- 2.2.2.8 Rotate the drag cam until the drag frame is fully raised.
- 2.2.2.9 Raise feed finger and pull terminal strip back until disengaged from applicator track. (Refer to Fig. 2.2.2 Fitting Terminal Strip) If preferred, cut the terminal carrier strip and pull it through the applicator with needle nose pliers.

2.2.3 Punch and Anvil Alignments

- 2.2.3.1 Turn off and disconnect power from the press. Remove the machine guards if necessary.
- 2.2.3.2 With a terminal in position over the anvils slightly release, both the front and the back, anvil mounting screws. (Refer to Figure 2.2.3.2 Anvil Alignment)

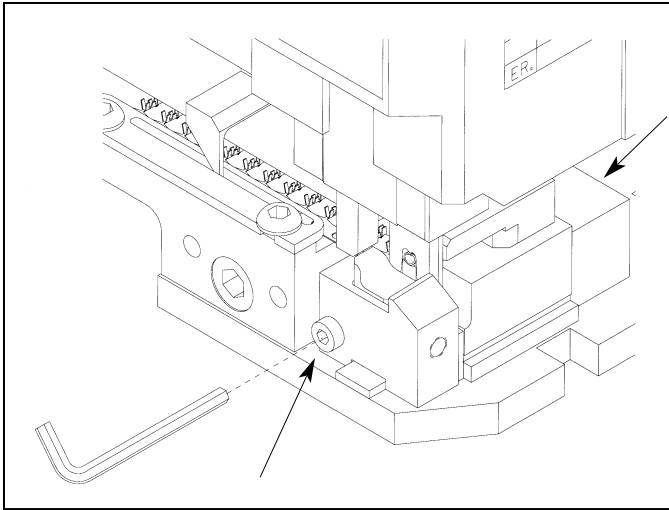


Figure 2.2.3.2 Anvil Alignment

2.2.3.3 Gently hand cycle the ram of the press to bottom of its stroke. In this position tighten anvil mounting screws to ensure perfect alignment of punches and anvils.

2.2.3.4 Hand cycle the press ram to the upper-most position.

2.3 Adjustments

2.3.1 Cover Plate Adjustments

2.3.1.1 Turn off and disconnect power from the press. Remove the machine guards if necessary.

2.3.1.2 Remove the applicator from the press. (Refer to section 2.2.1 Applicator Installation & Removal)

2.3.1.3 Rotate the drag cam to raise the drag frame. The rear cover plate should be adjusted so the terminal will slide smoothly through the track.

2.3.1.4 Some applicators require the removal of the applicator frame from the bolster plate. This is done by removing the two M6 button head cap screws located on the bottom of the bolster plate. (Refer to Fig. 2.3.1.4 - Frame Removal)

2.3.1.5 Loosen the two M4 socket head cap screws and adjust the position of the rear cover. Approximately 0.25mm (0.010") clearance between the cover plate and terminal strip is advised. (Refer to Fig. 2.3.1.6 - Cover Plate Positioning)

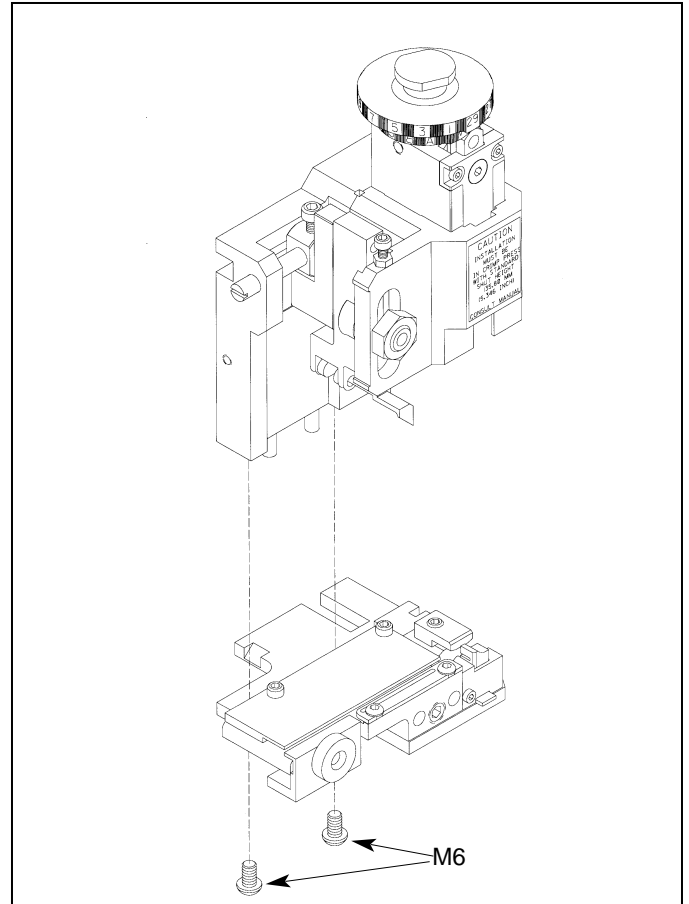


Figure 2.3.1.4 Frame Removal

2.3.1.6 Slide terminals through the track to ensure correct cover positioning.

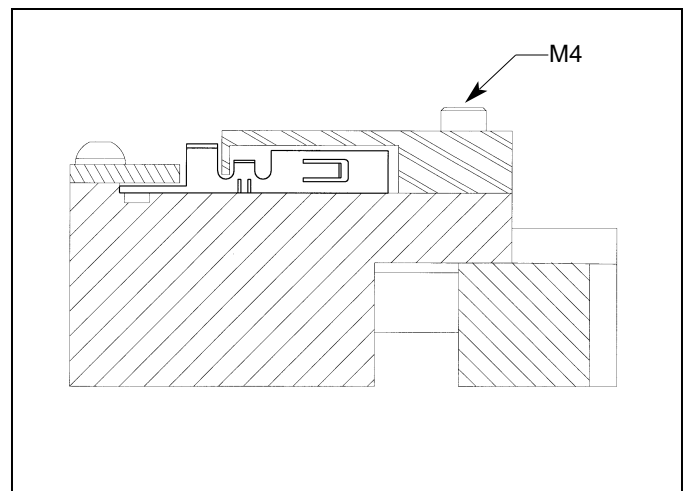


Figure 2.3.1.6 Cover Plate Positioning

2.3.1.7 After the correct position is achieved, tighten the two M4 socket head cap screws.

2.3.1.8 If necessary, reattach the applicator frame to the bolster plate. Locate the position of the frame using the dowel pins. Tighten the two M6 button head cap screws to secure the frame to the bolster plate.

2.3.2 Track Adjustments

2.3.2.1 Turn off and disconnect power from the press. Remove the machine guards if necessary.

2.3.2.2 To set the track in proper relation to the anvils and cut-off plunger, loosen the M12 set screw located on the front of the track. Depending on the required movement, the feed finger may need to be loosened.

2.3.2.3 Using a small screw driver, turn the adjusting screw to position the terminal in the correct position. Turning the screw clockwise will move the track towards the operator; to move the track into the applicator turn the screw counter-clockwise. (Refer Fig. 2.3.2.3 Adjusting Track)

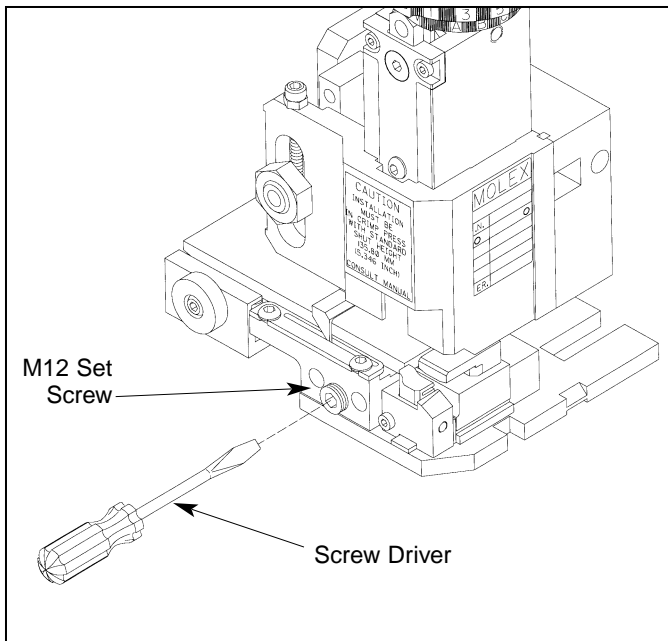


Figure 2.3.2.3 Adjusting Track

2.3.2.4 Tighten the M12 set screw to lock the track in position.

2.3.2.5 Replace machine guards, connect power, and turn press on.

2.3.2.6 Hand cycle the press to ensure the applicator is functioning properly. Then Crimp a terminal under power and observe the quality of the termination. (Refer to Chapter 4)

2.3.2.7 Adjustments may be necessary to the feed finger to position it correctly in location to the terminal. (Refer to section 2.3.3 Feed Finger Adjustments)

2.3.2.8 Repeat the above steps until the desired terminal position is obtained.

2.3.3 Feed Finger Adjustments

2.3.3.1 Position the feed finger to properly feed the next terminal in position. Typically terminals are fed by the carrier strip.

2.3.3.2 Turn off and disconnect power from the press. Remove the machine guards if necessary.

2.3.3.3 Remove the applicator from the press. (Refer to section 2.2.1 Applicator Installation & Removal)

2.3.3.4 Pull back the feed pivot lever to expose the feed finger mounting screw.

2.3.3.5 Loosen the M4 button head cap screw located on the feed arm and slide the feed finger to the desired position. (Refer to Fig. 2.3.3.5 Feed Finger Positioning)

2.3.3.6 Tighten the M4 screw to lock the feed finger in position.

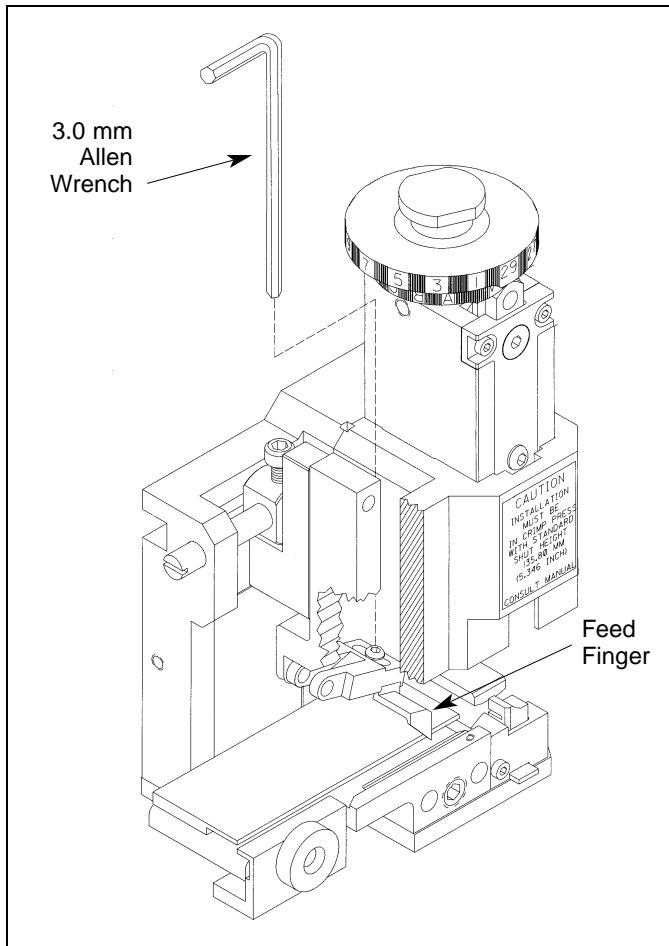


Figure 2.3.3.5 Feed Finger Positioning

2.3.4 Feed Stroke Cam Adjustments

2.3.4.1 The feed stroke to be employed by the ram depends upon the press stroke. Refer to the press manual to determine the proper stroke. A press with a 28.58mm (1 1/8") stroke uses a shorter feed cam than a press with a 41.28mm (1 5/8") stroke.

2.3.4.2 Determine the desired feed timing. Typically when the applicator is mounted in a wire processing machine, the feed stroke cam should be assembled in the down stroke position. While the press is idle in the up position, a terminal will not be present over the anvil. For most bench applications, the cam is installed in the up stroke position. This will leave a terminal over the anvil when the press is idle in the up position. (Refer to Fig. 2.3.4.2 Mounting Positions for the Feed Stroke Cam)

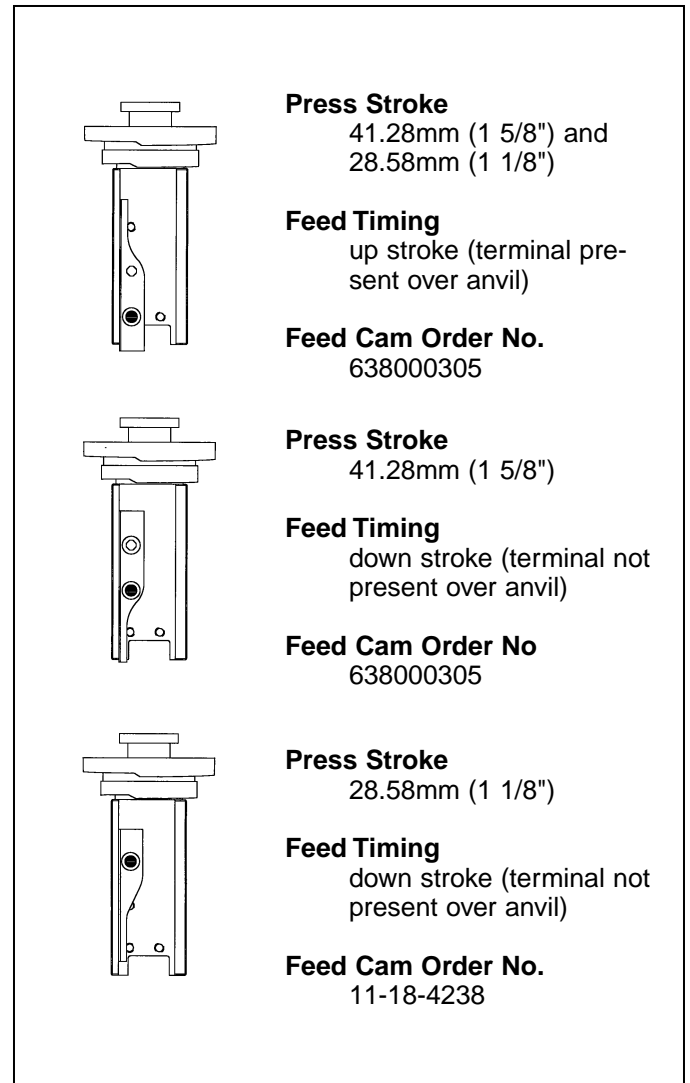


Figure 2.3.4.2 Mounting Positions for the Feed Stroke Cam

- 2.3.4.3 Turn off and disconnect power from the press. Remove the machine guards if necessary.
- 2.3.4.4 Remove the applicator from the press. (Refer to section 2.2.1 Applicator Installation & Removal)
- 2.3.4.5 Pull back the feed pivot lever and remove the ram from the applicator.
- 2.3.4.6 Remove the M4 socket head cap screw on the back of the ram, holding the feed cam.
- 2.3.4.7 Position the cam in the desired position for feeding and attach with the M4 screw. (Refer to Fig. 2.3.4.2 Mounting Positions for the Feed Stroke Cam)

2.3.5 Forward Feed Adjustments

- 2.3.5.1 To check the forward feed position, the terminal being crimped should be positioned exactly over the anvil.
- 2.3.5.2 Turn off and disconnect power from the press. Remove the machine guards if necessary.
- 2.3.5.3 Loosen the M5 socket head cap screw and turn the feed adjusting screw to reposition the terminal. To shorten the feed turn the adjusting screw clockwise; turning the adjusting screw counter-clockwise will lengthen the feed position. (Refer to Fig. 2.3.5.3 Forward Feed Positioning)

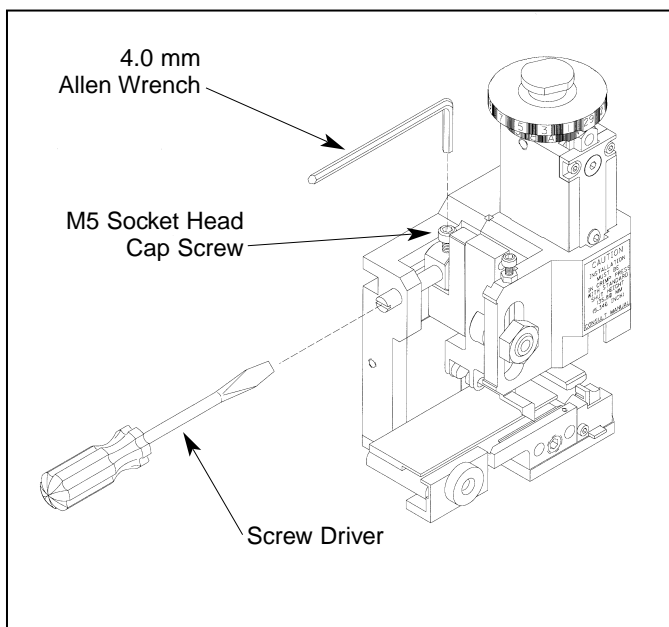


Figure 2.3.5.3 Forward Feed Positioning

- 2.3.5.4 After properly adjusting the forward feed position of the terminal, tighten the M5 socket head cap screw.

2.3.6 Back Stroke Feed Adjustments

- 2.3.6.1 The loaded terminal strip should have a little over-travel on the back stroke to pick up the next position.
- 2.3.6.2 Turn off and disconnect power from the press. Remove the machine guards if necessary.
- 2.3.6.3 Loosen the M12 hex jam nut to permit up and down movement of the hinge bushing. (Refer to Fig. 2.3.6.5 Back Stroke Feed Positioning)

- 2.3.6.4 With the press in the down position, loosen the M4 socket head cap screw.

- 2.3.6.5 Adjust the position of the hinge bushing to achieve the correct back stroke location. Lowering the hinge bushing in the support slot will shorten the stroke; raising the hinge bushing will lengthen the feed stroke. (Refer to Fig. 2.3.6.5 Back Stroke Feed Positioning)

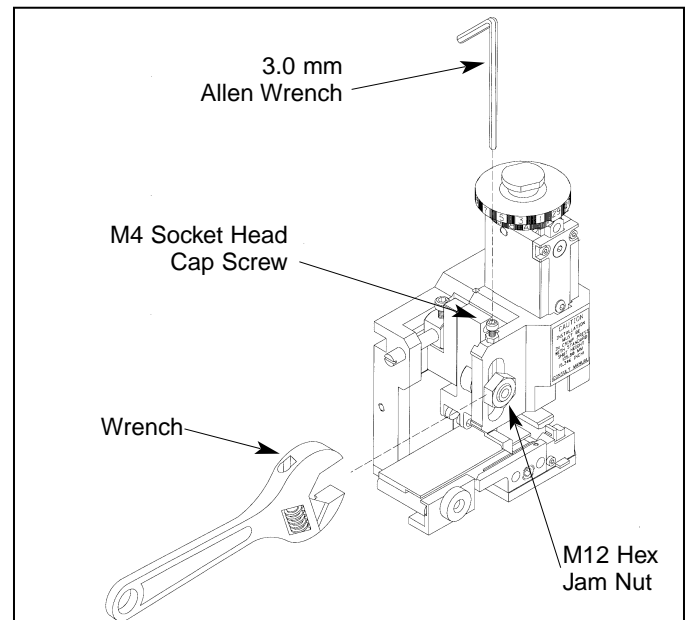


Figure 2.3.6.5 Back Stroke Feed Positioning

- 2.3.6.6 After the stroke is adjusted, tighten the M12 hex jam nut and bring the M4 socket head cap screw up against the hinge bushing.

- 2.3.6.7 Readjustment of the forward feed stroke could be necessary. (Refer to section 2.3.5)

2.3.7 Conductor Crimp Punch Adjustments

- 2.3.7.1 With the guards intact, place a stripped length of suitable wire into the terminal and terminate the wire under power.
- 2.3.7.2 Observe quality of initial conductor crimp and measure the crimp height. (Reference Section 4.3 Conductor Crimp Height Measurement)
- 2.3.7.3 If adjustments are necessary, turn off and disconnect power from the press. Remove the machine guards.

- 2.3.7.4 Rotate the conductor adjusting cam to achieve the desired crimp height. Each increment represents approximately 0.015mm (0.0006") for a total adjustment of 1.20mm (.047"). The "A" setting equates to the highest crimp height and the "N" setting the tightest. If you find that the crimp height is not achievable by rotating the adjusting cam, the shut height of the press should be checked. (Refer to section 2.1 Shut Height) Shimming of the applicator will never be necessary.

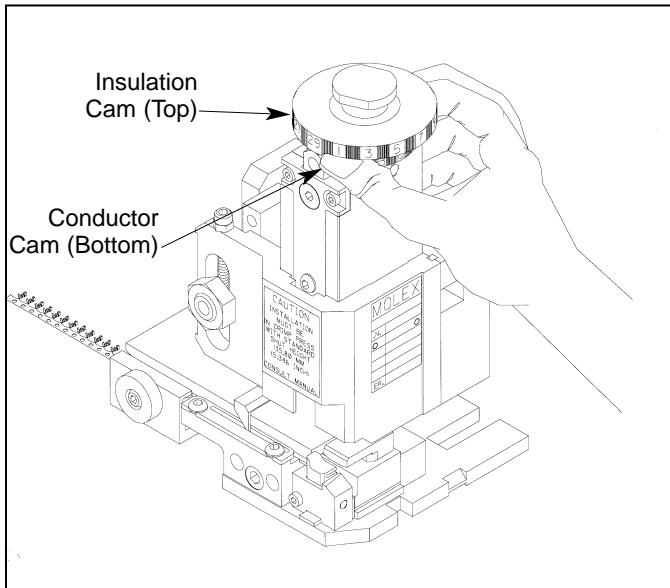


Figure 2.3.7.4 Adjusting Conductor Setting

- 2.3.7.5 Reinstall the machine guards and repeat the above steps until the desired crimp height is obtained. (Refer to section 4.3 Conductor Crimp Height Measurement)
- 2.3.7.6 Carry out pull test on conductor crimp to verify the mechanical integrity of the crimp. (Refer to section 4.5 Pull Force Test)

2.3.8 Insulation Crimp Punch Adjustment

- 2.3.8.1 Place a stripped length of suitable wire into the terminal and terminate to wire under power.
- 2.3.8.2 Observe quality of initial insulation crimp and measure the crimp height. (Reference Section 4.4 Insulation Crimp)

- 2.3.8.3 If adjustments are necessary, turn off and disconnect power from the press. Remove the machine guards.
- 2.3.8.4 Rotate the insulation adjusting cam to achieve the desired insulation height. Each increment represents approximately 0.06mm (0.0025") for a total adjustment of 1.58mm (.062"). The "1" setting equates to the highest crimp height and the "29" setting the tightest.
- 2.3.8.5 Repeat the above steps until the desired insulation height is obtained.

Note

Due to the large variety of insulation wall thickness, materials, and duramater, Molex does not specify insulation crimp height. For each different wire type, the insulation crimp height should be measured, recorded and inspected as a quality indicator.

2.3.9 Wire Stop Adjustment

For automatic wire processing machines the wire stop can be used to assist in the stripping of the terminal from the punches. However, in certain circumstances the wire stop will need to be removed when running on an automated machine.

- 2.3.9.1 Check the setup documents to obtain the correct strip length.
- 2.3.9.2 Place the wire into the terminal and terminate the wire under power.
- 2.3.9.3 Observe quality of initial crimp and the wire position. (Reference Section 4.1 Conductor Brush and Terminal Position)
- 2.3.9.4 If adjustments are necessary, turn off and disconnect power from the press. Remove the machine guards.
- 2.3.9.5 Loosen the M5 socket head cap screw located on the side of the frame. (Refer to Fig. 2.3.9.5 - Wire Stop Positioning)

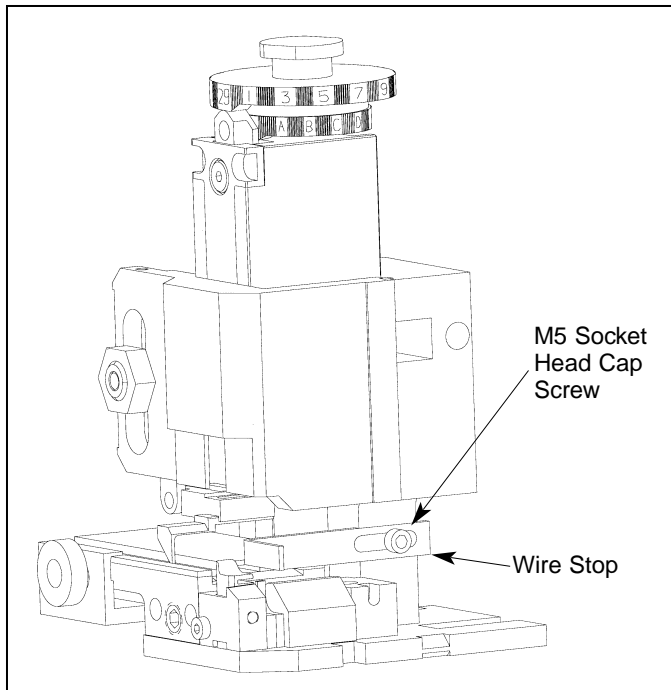


Figure 2.3.9.5 Wire Stop Positioning

- 2.3.9.6 Adjust the position of the wire stop. Forward to decrease the insertion depth of the wire and backward to decrease.
- 2.3.9.7 Hand cycle the press to ensure the applicator is functioning properly. Then Crimp a terminal under power and observe the quality of the termination. (Refer to Chapter 4)

2.4 Tooling Removal

2.4.1 Removal of the Top Tooling (Punches)

- 2.4.1.1 Turn off and disconnect power from the press. Remove the machine guards if necessary.
- 2.4.1.2 Remove the applicator from the press. (Refer to section 2.2.1 Applicator Installation & Removal)
- 2.4.1.3 Pull back the feed arm and remove the ram from the applicator.
- 2.4.1.4 With a small screw driver, push in the button located on the front of the ram. (Refer to Fig. 2.4.1.4 Punch Removal)
- 2.4.1.5 Pull the punches out the bottom of the ram.

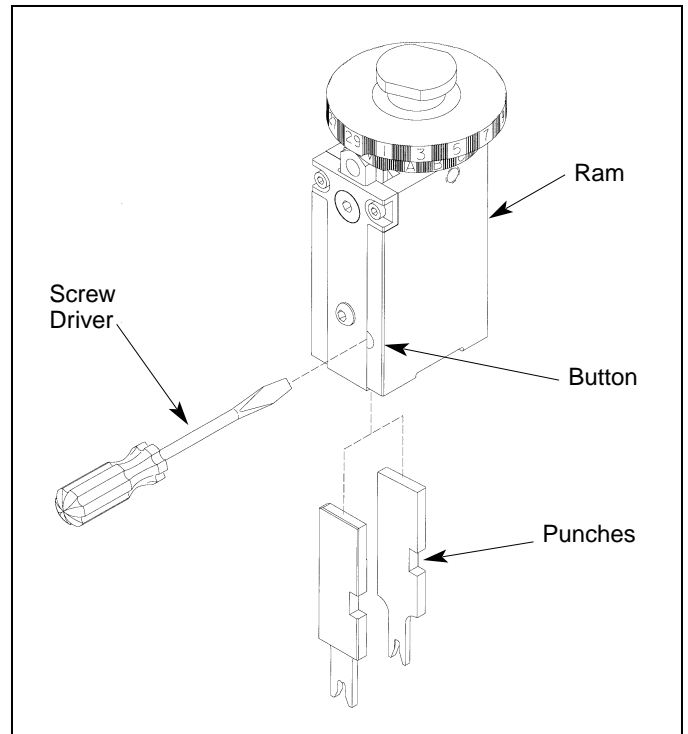


Figure 2.4.1.4 Punch Removal

- 2.4.1.6 Reverse the above steps to reinstall the punches.

2.4.2 Removal of the Bottom Tooling (Anvils)

- 2.4.2.1 Turn off and disconnect power from the press. Remove the machine guards if necessary.
- 2.4.2.2 Remove the applicator from the press. (Refer to section 2.2.1 Applicator Installation & Removal)
- 2.4.2.3 Pull back the feed arm and raise the ram.
- 2.4.2.4 Remove the M4 socket head screws holding the bottom tooling in place.
- 2.4.2.5 After replacing the bottom tooling, leave the mounting screw loose. (for tightening Refer to section 2.2.3 Punch and Anvil Alignment)

Chapter 3

Maintenance

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3.1 Cleaning and Lubrication

3.1.1 Storage

To prevent bottoming of the ram, which might cause damage to the punches and anvils, leave a strip of terminals in the applicator or place a piece of wood or rubber between the punches and anvils.

3.1.2 Cleaning

The applicator should be cleaned every day while not in storage. Use a clean, dry cloth or soft brush to remove all dirt, slugs and chips from the applicator.

3.1.3 Lubrication

Grease the ram including the up and down stroke feed cam, the feed finger assembly, and all moving parts. It is recommended the applicator be lubricated with a multipurpose synthetic lubricant with Teflon or an equivalent. Molex ships its applicators pre-greased with Permatex Industrial super lube #82329.

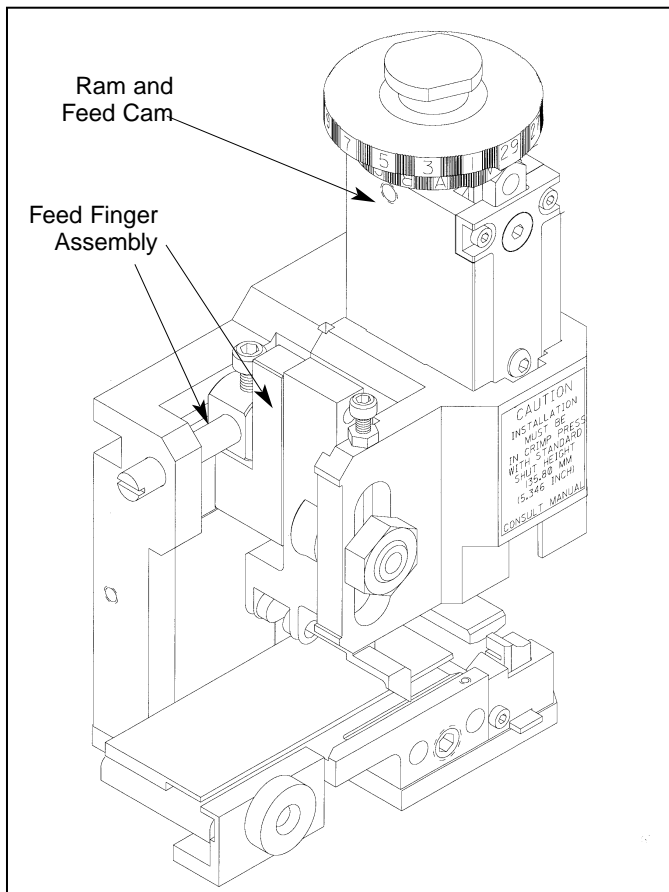


Figure 3.1.3 Lubrication

3.2 Bill of Material

Part No.	Qty.	Description			
63800-0301	1	Back Frame	63800-0123	1	Slider, Feed Cam
63800-0302	1	Face Plate	63800-0124	1	Pin, Feed Adjusting
63800-0303	1	Base Plate	63800-0125	1	Torsion Spring
63800-0304	1	Ram	69028-0640	1	Spring - Extension
63800-0305	1	Feed Cam	63800-012	1	Spring
63800-0306	1	Insulation Striker	63800-0129	1	Washer - 3.40 Thick
11-18-4238	1	Feed Cam (Short)	63800-0330	1	Lug Bolt
63800-0308	1	Terminal Track	63800-0331	1	Cond. Adjusting Cam
63800-0309	1	Rear Support Block	63800-0332	1	Insul. Adjusting Cam
63800-0310	1	Adjusting Screw	69028-0808	1	Washer - 0.15 Thick
63800-0311	1	Locking Screw	69028-0809	1	Washer - 0.18 Thick
63800-0312	1	Drag Frame	69028-0836	2	Snap Ring
63800-0313	1	Drag Cam	69028-0125	1	Shoulder Screw
69028-0660	4	Drag Springs	69028-0133	1	Self Locking Nut
63800-0314	1	Retaining Bar	63800-0140	1	Cylindrical Pin
63800-0115	1	Spacer Tube	63800-0141	1	Slider
63800-0316	2	Guide Pin, Drag Frame	63800-0142	1	Roller Cam Follower
63800-0117	1	Feed Pawl Lever	63800-0143	1	Pin Cam Follower
63800-0118	1	Hinge Bushing	63800-0144	2	Key Stock
63800-0119	1	Feed Finger	63800-0345	1	Retaining Plate
63800-0120	1	Feed Arm	63800-0346	1	Conductor Striker
63800-0121	1	Lever, Feed Pivot	63800-0347	1	Retaining Rod
63800-0122	1	Feed Adjusting Screw	63800-0348	1	Detent Spacer
			11-32-5346	4	M4 Ball Spring Plunger

Please refer to Fig. 3.3 for assembly drawing (exploded view)

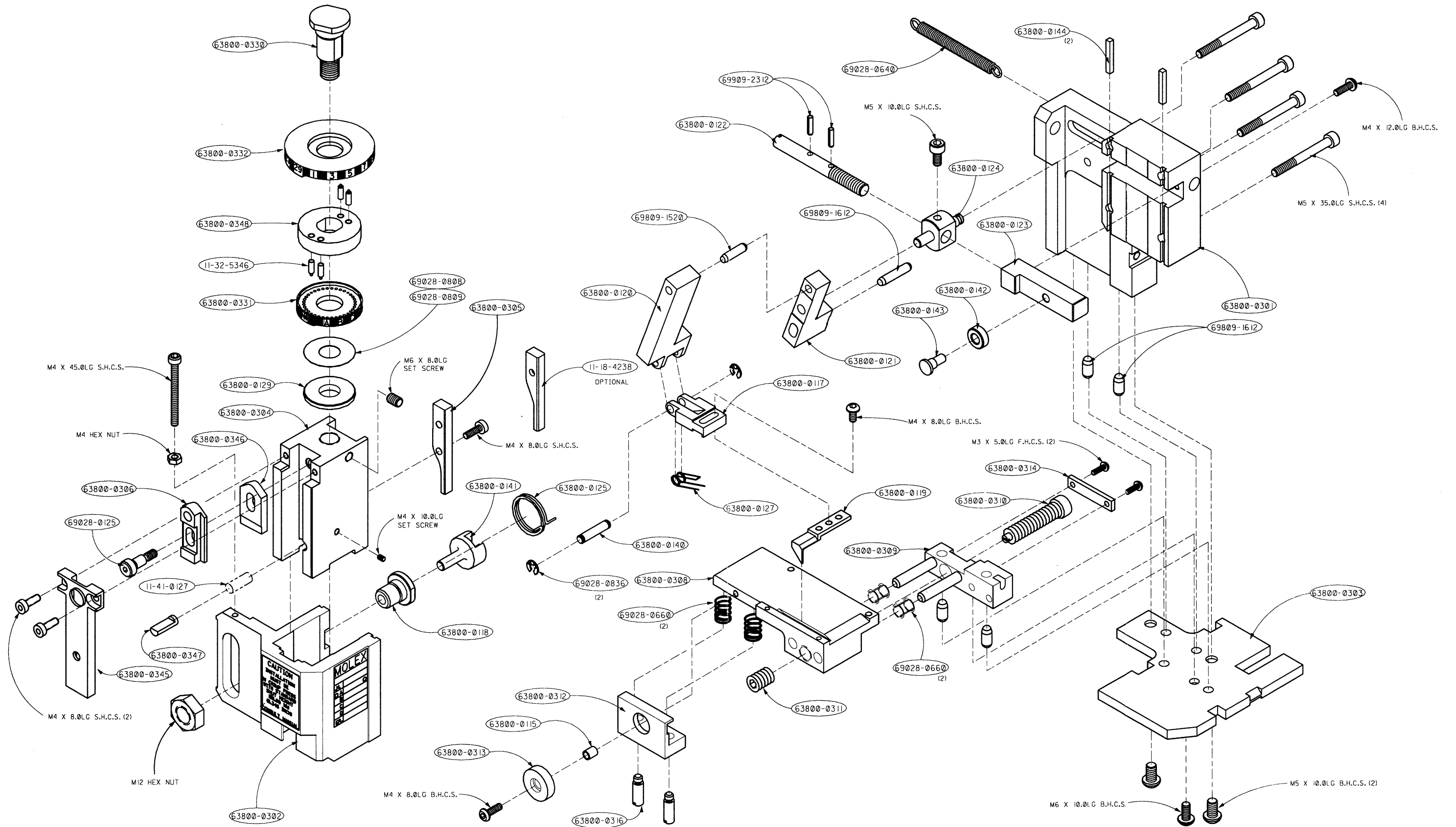


Figure 3.3 Assembly Drawing (exploded view)

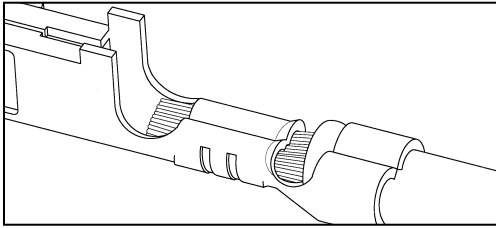
Chapter 4

Crimp Termination's

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4.1 Conductor Brush & Terminal Position	21
4.2 Conductor Bellmouth & Terminal Cut-Off Tab	22
4.3 Conductor Crimp Height Measurement	23
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4.5 Pull Force Testing	26

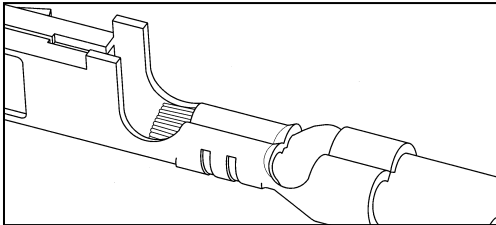
4.1 Conductor Brush & Terminal Position

4.1.1 Optimum crimp setup.



Cause: Insulation edge centered in the middle of the transition area. Conductor brush at nominal specification, centered in the transition area, with the strip length at nominal dimension.

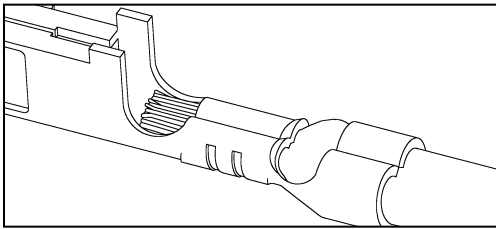
4.1.2 Insulation under conductor crimp, good conductor brush length.



Cause: Strip length too short.

Solution: Verify strip length specification, adjust as necessary.

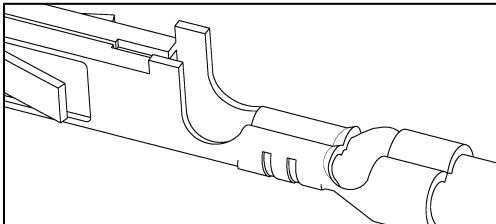
4.1.3 Insulation under conductor crimp, long conductor brush length.



Cause: 1) a) Bench press - Wire stop position incorrect.
b) Automatic wire processing - Press position set too far in.

Solution: 1) a) Bench press - Adjust wire stop to center the insulation in the transition area.
b) Automatic wire processing - Adjust press position away from wire.

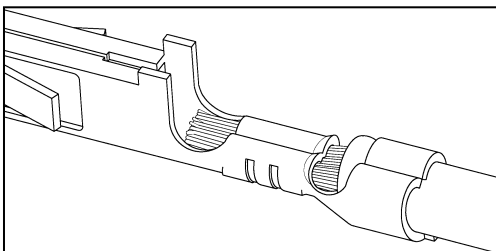
4.1.4 Insulation under conductor crimp, short or no conductor brush length.



Cause: 1) Strip length too short
2) a) Bench press - Wire stop position incorrect.
b) Automatic wire processing - Press position set too far in.

Solution: 1) Verify strip length specification, adjust as necessary.
2) a) Bench press - Adjust wire stop to center the insulation in the transition area.
b) Automatic wire processing - Adjust press position away from wire.

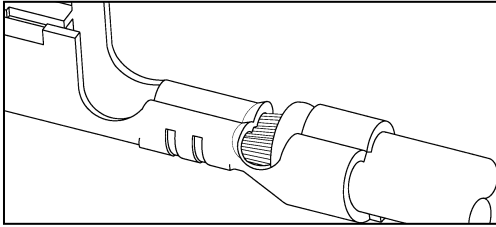
4.1.5 Insulation edge centered in the transition area, conductor brush too long.



Cause: 1) Strip length too long.
2) Irregular wire cut-off or wire strands pulled from insulation bundle.

Solution: 1) Verify strip length specification, adjust as necessary. Readjust wire stop for bench applications.
2) Check for worn stripping blades.

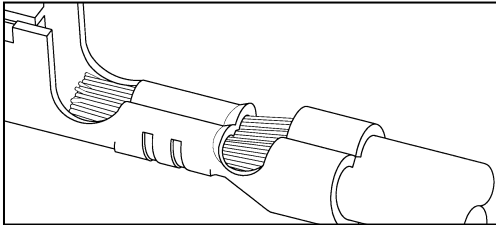
4.1.6 Insulation edge in the center of transition area, conductor brush too short.



Cause: Strip length too short.

Solution: Verify strip length specification, adjust as necessary. Readjust wire stop for bench applications.

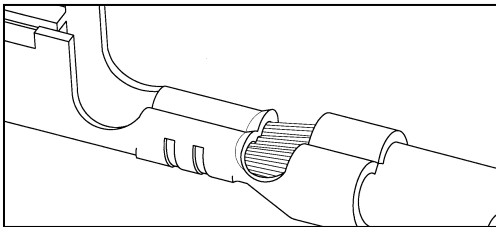
4.1.7 Insulation edge under insulation crimp form, good or long conductor brush length.



Cause: Strip length too long.

Solution: Verify strip length specification, adjust as necessary. Adjust the wire stop for bench applications, or press position on wire processors if necessary.

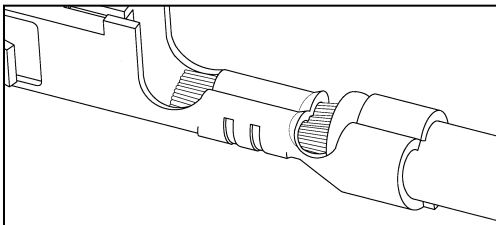
4.1.8 Insulation edge under insulation crimp form, short or no conductor brush length.



Cause: 1) a) Bench press - Wire stop position incorrect.
b) Automatic wire processing - Press position set too far out.
2) Verify operators wire placement ability, or crimp rate.

Solution: 1) a) Bench press - Adjust wire stop to center the insulation in the transition area.
b) Automatic wire processing - Adjust press position closer to wire.
2) Operator training, reduce crimping rate.

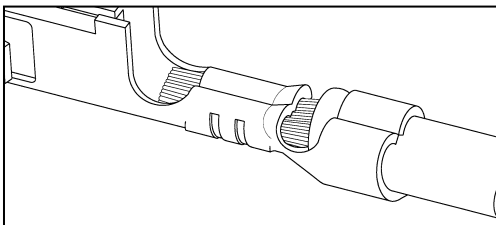
4.2 Conductor Bellmouth & Terminal Cut-off Tab



4.2.1 Optimum crimp setup.

Cause: Tooling was setup to produce conductor bellmouth to nominal specification, and/or approximately 2x terminal material thickness. the Cut-off tab is approximately 1x terminal material thickness.

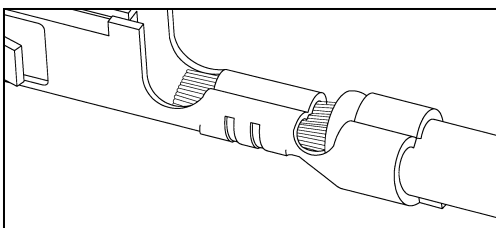
4.2.2 Excessive bellmouth, cut-off tab flush with insulation crimp.



Cause: 1) Terminal to tooling position.
2) Camber in the terminal strip.

Solution: 1) Verify pull force.
2) Adjust terminal track into the applicator.

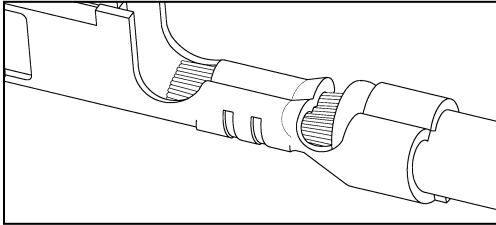
4.2.3 No or small bellmouth, long cut-off tab.



Cause: 1) Terminal to tooling position.
2) Camber in the terminal strip.

Solution: 1) Verify pull force.
2) Adjust terminal track towards operator.

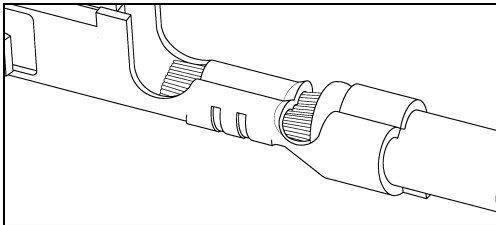
4.2.4 Excessive bellmouth, good cut-off tab.



Cause: 1) Check for worn conductor punch tooling.
2) Check for correct conductor punch tooling.

Solution: 1/2) Replace tooling if necessary.

4.2.5 Excessive cut-off tab, good conductor bellmouth.



Cause: 1) Check for worn cut-off tooling.
2) Check for correct cut-off tooling.

Solution: 1/2) Replace tooling if necessary.

4.3 Crimp Height Measurement

4.3.1 Crimp Height Off Target

Cause:

- 1) Changed wire type, stranding, or vendor
- 2) Changed insulation color or durometer
- 3) Changed crimp tooling
- 4) Changed crimping press (shut height)
- 5) Changed press type (manufacturer)
- 6) Changed terminal reel (lot code)
- 7) Changed tooling set-up
- 8) Damaged or worn tooling

Solution: Adjust tooling back to target (Refer to Section 2.3.7 Conductor Crimp Punch Adjustments)

4.3.2 Crimp Height Variability to High

Cause:

- 1) Wire variability
- 2) Terminal variability
- 3) Damaged, loose, or worn tooling
- 4) Measurement error *
- 5) Terminal spring back to great **
- 6) Cut or missing wire strands

Solution:

- 1/2) Inspect incoming product for variability
- 3) Tooling replacement or tightening
- 4) Gage capability analysis
- 5) Tooling crimp height adjustment
- 6) Stripping process adjustment

* Most common cause of crimp height variability

** It is normal for a termination to spring back to a final crimp position after crimping. It is possible to achieve the same final crimp height with two different tool height setup's. This is due to the inherent spring back characteristics of a terminal and wire combination. The tighter the crimp, the more it may spring back. One may adjust the crimp tool 0.05mm (.002") tighter and measure a crimp height change of only 0.03mm (.001").

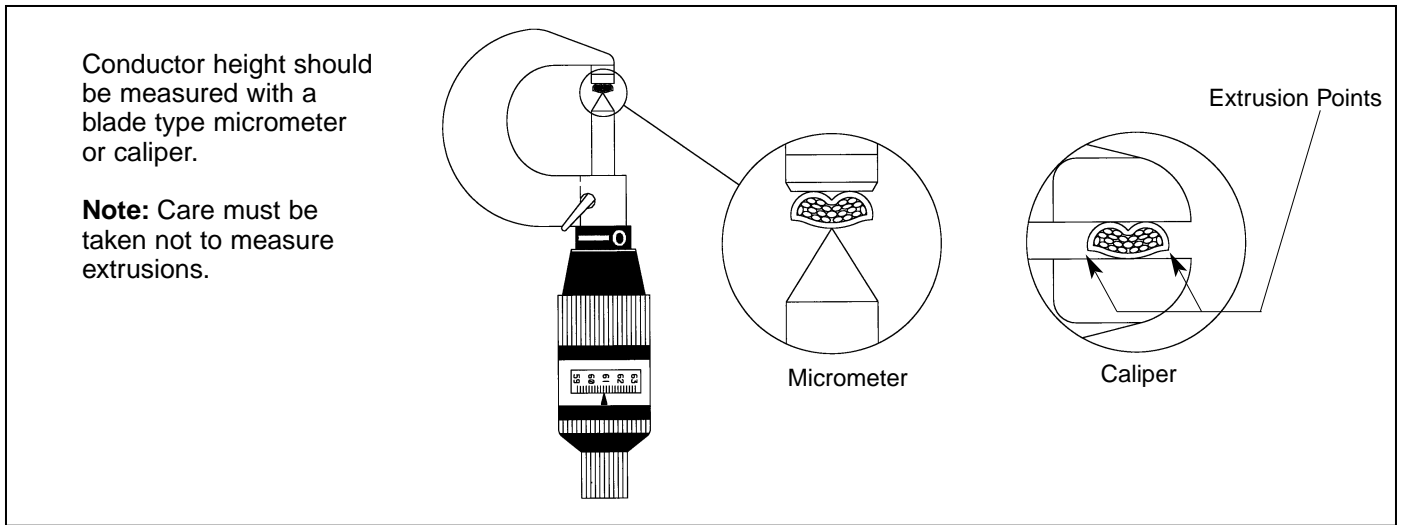
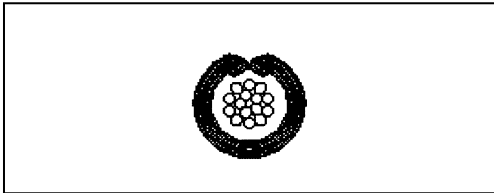


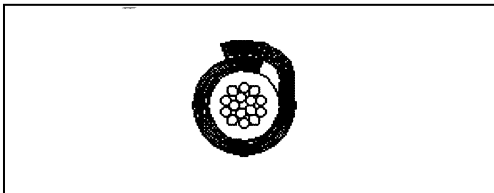
Figure 4.3 Crimp Height Measurement

4.4 Insulation Crimp

4.4.1 Preferred Insulation Crimp

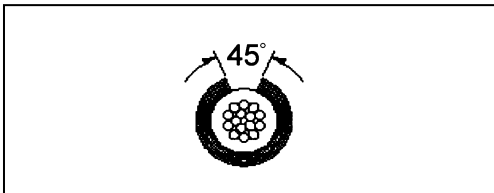


- a) It is preferred that the insulation crimp completely surround the outside diameter of the insulation. The terminal should hold on to the wire as firmly as possible without cutting through to the conductor strands. It should be noted that a preferred crimp only occurs in a small portion of the full insulation range a terminal can accommodate. A preferred insulation crimp is recommended for high vibration or movement applications.



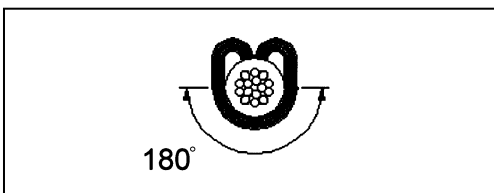
- b) An overlap insulation crimp is normally only developed for high vibration or movement applications where the wire diameter is near the lower terminal specification limit.

4.4.2 Acceptable Insulation Crimp



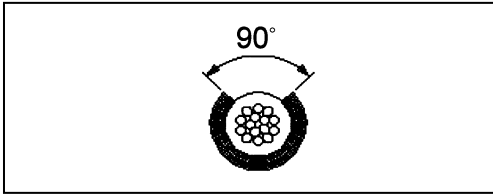
A terminal is normally specified to cover a wide range of insulation wall thickness over a range of wire sizes. Within this specified range, an insulation diameter may not completely surround the wire or fully hold the full diameter of the wire. This condition will still give an acceptable insulation crimp for most applications.

- a) A large insulation should firmly grip at least 88% of the wire.



- b) A smaller insulation should firmly grip at least 50% of the wire and firmly hold the top of the wire.

4.4.3 Marginal Insulation Crimp

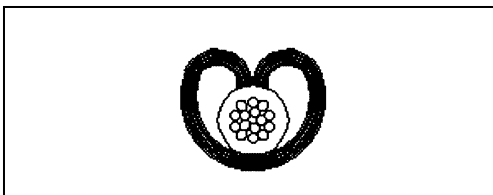


A Insulation diameter near the maximum and minimum specification of a terminal may cover less than what is normally considered acceptable. These strain relief's should only be used on applications which have low vibration or movement.

a) An insulation crimp that covers less than 88% of a large insulation diameter -

Cause: Not enough terminal grip length.

Solution: 1) Evaluate if the same terminal is available in a different wire range.
2) Try crimping the wire one setting tighter. This will embed the terminal more into the insulation. The insulation wall thickness is normally enough, therefore cutting strands is not a worry. Terminal insulation grips kicking back away from the terminal or slight insulation bulging may be noticed. Evaluate the terminal loaded into a housing for acceptability.

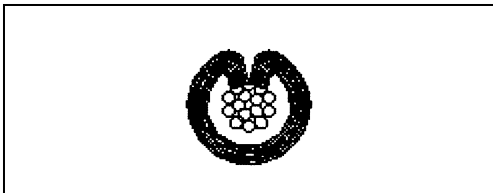


b) An insulation crimp that covers less than 50% of a small insulation diameter.

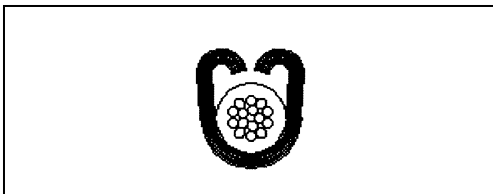
Cause: Too much terminal grip.

Solution: 1) Evaluate if the same terminal is available in a different wire range.
2) Evaluate if overlap crimp tooling is available.

4.4.4 Marginal Insulation Crimp



Insulation diameters which are small, thin walled insulated wire, and hand tool applications may create an insulation crimp that is normally not considered acceptable. A loose crimp assures no strand damage and offers insulation containment. Insulation crimps that pierce through the insulation will offer more strain relief. The insulation terminal grips will mostly push the strands to the side. Yet, there is always the possibility that a wire strand could be nicked. In severe cases, a wire strand may be cut. Careful application evaluation is needed for both of these cases.



Cause: 1) Crimp tooling adjustment.
2) Wire diameter variability.

4.5 Pull Force Testing

4.5.1 Pull Force Procedure - Wire connectors and soldering lugs for use with copper conductors. (Per UL486A October 8, 1991) U.L. Section 12 -- Pullout Test

12.1 "The connectors subjected to the static heating test or secureness test shall be subjected to a direct pull of the value specified for one minute. Only those conductors that have been subjected to the secureness test are to be subjected to the pullout test. The connector is acceptable if it does not become separated from the conductor or conductors after completion of the test.

12.2 For insulated connector in which the insulation is assembled to the connector during installation, the test should be conducted with the insulation in place if it is always supplied with the connector by the manufacturer. Otherwise, the test should be conducted without the insulation assembled to the connector. Breaking or tearing of the insulation of an insulated connector is acceptable in the pullout test. The pull is to be exerted by means of a tension testing machine or equivalent, so that there will be no sudden application of force or jerking during the test.

The following is the procedure Molex uses for the qualification of pull force.

- 1) Cut wire length approximately 6 inches (152 mm) long.
- 2) Strip one end to 1/2 inch (13 mm) or long enough so no wire insulation is under the insulation grip, or leave the insulation grip loose or open.
- 3) Terminate the appropriate terminal to the wire to the nominal crimp height.
- 4) Visually inspect the termination for bell-mouth, wire brush, and cut strands.
- 5) Set pull tester to 2" per minute (50 mm/min). For most application, a higher rate will not have a significant impact on the data. Verify higher pull rates with data taken at 2" per minute.
- 6) Knot the UN-terminated end of the wire.
- 7) Regardless of pull tester type, both wire and terminated end must be securely clamped. (Note: Clamp terminal contact interface, do not clamp conductor crimp)
- 8) Activate pull test at 2" per minute.
- 9) Record a minimum of 25 readings of maximum pull force. After the application has been qualified, a minimum of 5 pull force measurements should be done to confirm each set-up.
- 10) Compare lowest reading to minimum pull force specification.

4.5.2 Wire breaks before conductor grip, pull force low

Material Evaluation

Cause: Wire material properties, and/or coatings

Solution: Test non-terminated wire for breaking strength

Stripping Evaluation

Cause: Cut or nicked strands from stripping operation

- 1) Wire being manually stripped
- 2) Poor automatic stripping cut-off
- 3) Worn strip tooling

Solution: 1) Switch to semi-automatic or automatic wire stripping machine
2/3) Correct stripping machine setup

4.5.3 Wire pulls out of conductor grip, crimp height good

Material Evaluation

Cause: 1) Terminal material thickness too small
2) Terminal serration depth/form
3) Terminal plating thickness
4) Gold plating application

Solution: 1) Evaluate a new terminal
2/3) Contact terminal manufacturer
4) Evaluate selective gold application

Stripping Evaluation

Cause: Wrong strip length, poor conductor brush

Solution: Adjust strip length

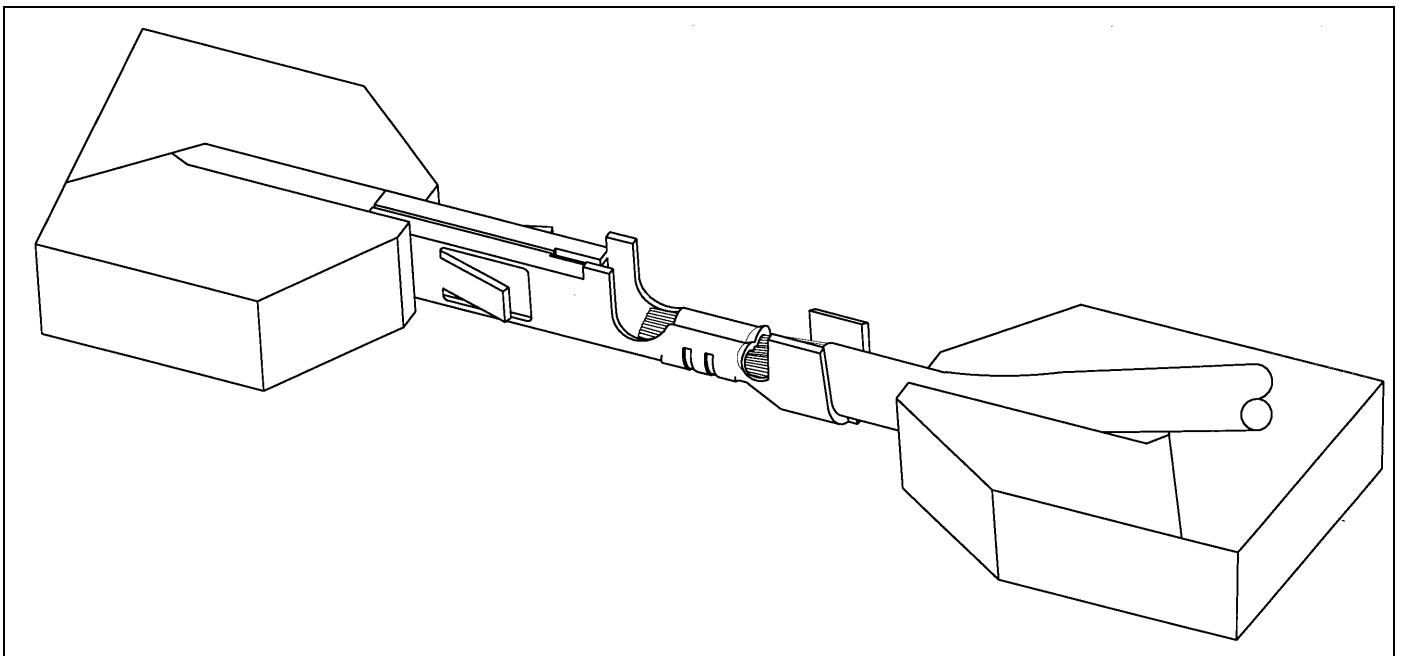


Figure 4.5 Pull Force Testing

Chapter 5

Statistical Process Control (Summary)

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5.1 Crimp Process Control	29
5.2 Process Capability	29
5.3 Production	30

5.1 Crimp Process Control

The crimp process is the interaction of a terminal, wire, tooling, personnel, methods and procedures, and environmental attributes that, when controlled, produce a quality termination. Quality control is an important aspect to quality crimping. It should not take excessive setup or inspection time to implement, and can save a harness manufacturer thousands of dollars in potential rework or re-manufacturing.

The key to quality is to target nominal specifications while continuously reducing variability. Achieving target is determined by the adjustability of the tooling. The FineAdjust applicator allows crimp height adjustment to .005 mm (.0002 in) of target.

Variability is the slight changes that occur from crimp to crimp. There are two types of variability, common and special. Common sources of variation are those causes that affect the process uniformly, and are created from numerous small sources. Common variability are inherent tolerances within a reel of wire or terminals. Also, common variability is created by the natural tolerances of the stripping and crimping machines. Reduction of variability at the common level normally has to come from changes at the wire, terminal, and tooling manufacturer.

The second source of variability is referred to as special cause. Unlike common cause, special sources of variation occur irregularly and unpredictably. Without checks throughout a run, a tool becoming loose after the first hundred crimps, stripping problems, or a damaged tool from a jam, may be undetected until thousands of crimps are made.

5.2 Process Capability

Molex qualifies each FineAdjust applicator design for pull force and conductor crimp height.

This qualification is performed on a common wire stranding, and is targeted at 2 CpK. Before a new crimping tool is put in production, it is recommended that a capability study be done by the customer using their specific wire in their process. A capability study is based on the assumption of a normal distribution (bell-type curve). It provides an estimate on the probability of a measurement being outside of specification.

CpK	+/- Sigma	% Yield	PPM
0.67	2	95.45	45,500
1	3	99.73	2,699
1.33	4	99.99	63
1.67	5	99.99+	0.57
2	6	99.99++	0

PPM - Parts per million potential defects.

A minimum of a 25 piece sample should be run off the crimping process. The average and standard deviation should be calculated for each specification.

A capability index defined by the formula below. Cp may range in value from 0 to infinity, with a larger value indicating a more capable process. A value >1.33 is normally considered acceptable.

$$\frac{\text{Tolerance}}{6 \times \text{Standard Deviation}}$$

The CpK index indicates whether the process will produce units within the tolerance limits. CpK has a value equal to Cp if the process is centered on the mean of specification; if CpK is negative, the process mean is outside the specification limits; if CpK is between 0 and 1 then some of the 6 sigma spread falls outside the tolerance limits. If CpK is larger than 1, the 6 sigma spread is completely within the tolerance limits. CpK is calculated with the lesser of the following formulas:

$$\frac{(\text{USL} - \text{MEAN})}{3 \times \text{Standard Deviation}}$$

$$\frac{(\text{MEAN} - \text{LSL})}{3 \times \text{Standard Deviation}}$$

USL = Upper Specification Limit,

LSL = Lower Specification Limit

Six sigma is a goal of many companies because it represents virtually zero defects. The ability of a company to achieve a six sigma level is dependent on the amount of common variability in their process. Hand stripping of the wire will produce more variability than a stripping machine. A crimping hand tool will produce more variability than a press and die set. Bench termination's will produce more variability than a wire processing machine.

A portion of the variability in crimping will come from what instruments are used to measure the parts and the ability of an operator to repeat the measurement. A crimp micrometer will measure more accurately than a dial caliper. An automatic pull force system will measure better than a hook type scale. It is important that the measurement gage has enough resolution. Two operators may measure the same part differently, or the same operator may measure the part differently when using two types of gages. A gage capability study is recommended to identify what part of the variability is coming from measurement error. Micro-terminals crimped to small wire sizes need a tight crimp height range to maintain pull force. The variability from measurement error can keep CpK's low.

The capability of the crimping tools should be re-confirmed if the production data is significantly different from the capability study.

5.3 Production

Once the level of capability is established, the tool is ready for production.

Many harness manufacturer's run only a few hundred or few thousand wire at one time. In this case, it is not practical or economical to run a twenty-five piece capability with every set-up.

5.3.1 Setup Confirmation

After the setup of the crimping process, crimp five terminals with a loose insulation crimp. Visually inspect or measure bellmouth, cut-off tab length, conductor brush, insulation position, and conductor crimp height. Make the appropriate adjustments to the machine. (Refer to trouble shooting sections if needed). After all adjustments have been made, crimp five more samples for pull force evaluation. The pull force is a good indicator for cut or nicked strands, short conductor brush, small bellmouth, or incorrect crimp height. Calculate the average. Compare the average and minimum reading with the capability study data.

After the pull force has been confirmed, Set the insulation crimp to the appropriate setting. Re-check crimp height and make adjustments if necessary.

Crimp five more samples and document average crimp height, the maximum reading, and the minimum reading. The Range is considered the maximum reading minus the minimum reading. With a crimp micrometer and a experienced operator, the range for crimp termination's is normally only a few ten thousandth of an inch. This data becomes the first point on the control chart.

5.3.2 Production (Control Charting)

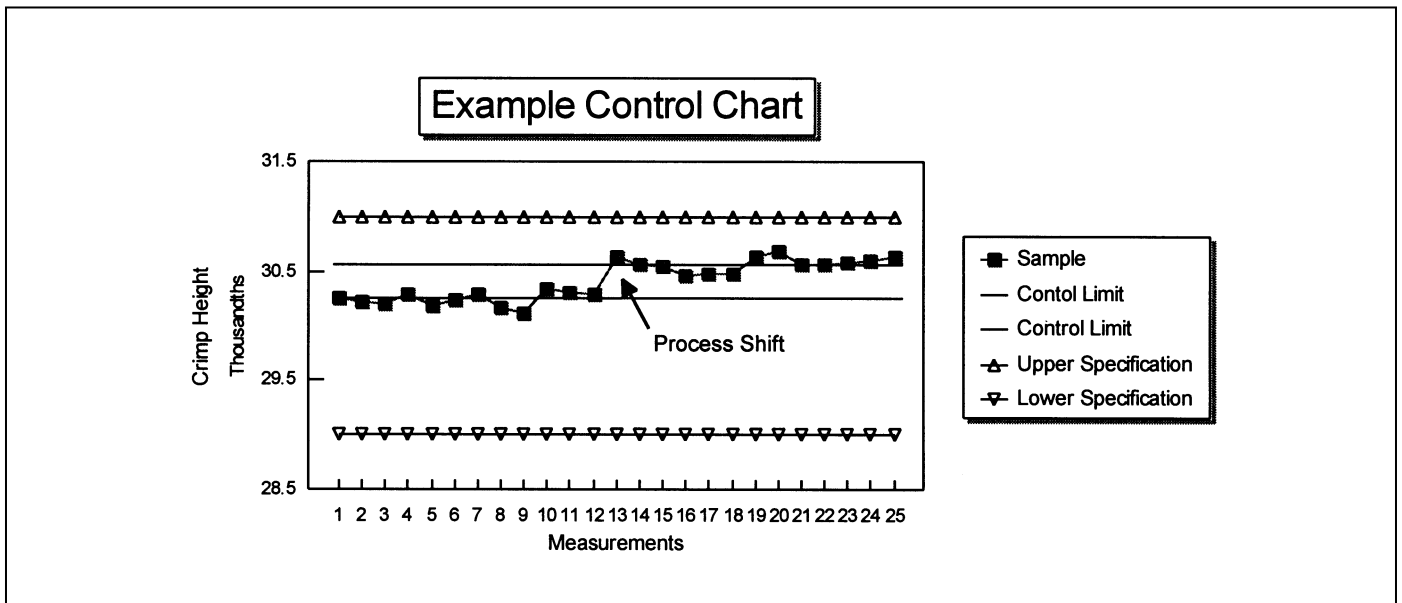
It should be normal procedure for the operator to visually fan each bundle of crimped wires and visually check bellmouth, conductor brush, insulation position, cut-off tab length, and insulation crimp. Crimp height should be checked throughout the run. The frequency of each check is determined by the risk you wish to take for scraping parts. A check every 250 to 500 parts is recommended.

Control Charting

Crimp Height is normally control charted since it is a quick nondestructive measurement and is critical for the electrical reliability of the termination.

There are three primary purposes for control charting. First, the number of setup samples are normally small, and its statistical value is limited. Second, since special cause effects on a process are irregular and unpredictable, it is necessary to have a means of catching changes in the process as soon as they occur. This prevents thousands of termination's from being scraped after the run is over. Third and most important, this data is necessary to assess and improve the crimp process.

Once the tooling process is setup and the wire size is not changing, keep one control chart for wire color changes, wire length changes, terminal material changes, or setup adjustments. Record the data point on the chart before a crimp height adjustment is made. If data is recorded after each adjustment, the process most likely will assume control and provide little data for improving the process. Write as many notes on the chart as possible. The only truly effective and economically sensible manner of managing a manufacturing process is to understand, monitor, and reduce sources of variability inherent to the process itself. Every minute the process is down for setup or adjustment is unproductive.



X & R Chart

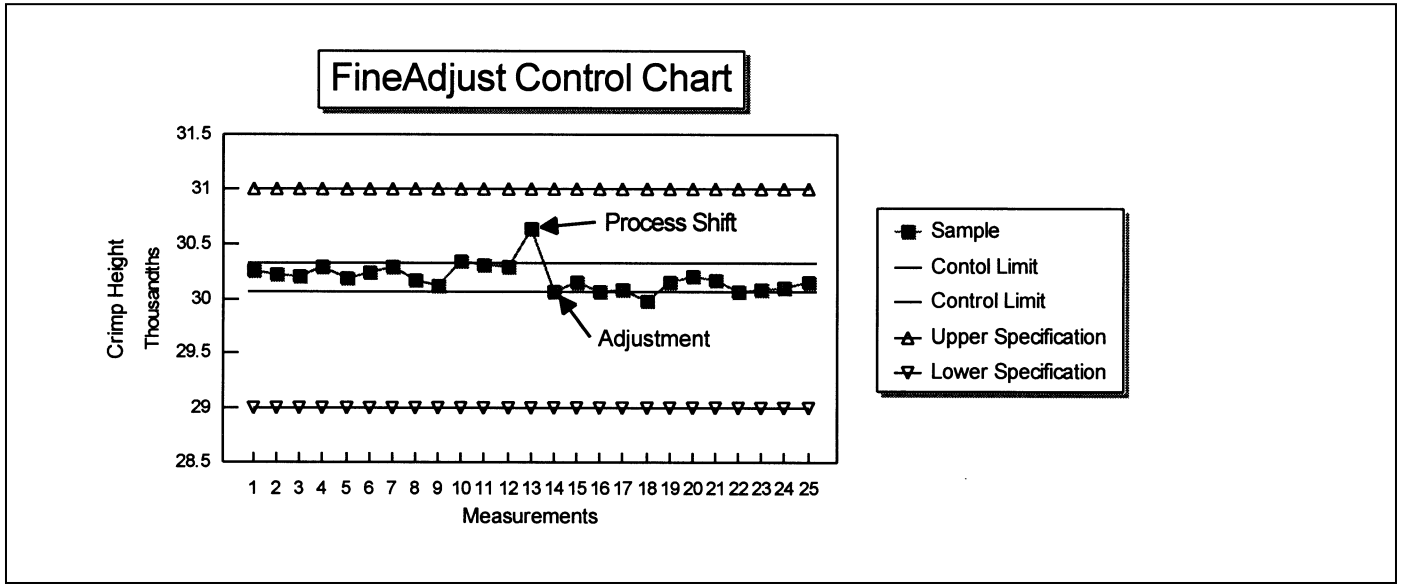
Control Limit for sample of 5 = Avg (Avg. of 5 readings) + .577 x Avg (Max.-Min. of 5 readings)

What does this sample chart tell us? A process shift occurred between measurement 12 and 13. This type of shift could occur due to a change in wire, a change in terminal lots, a jam in the machine that damaged the tooling, a change in operators, or an adjustment to the insulation crimp. Since the measurements are still within specification, would you stop production to adjust crimp height?

A shift in the process due to a change in material may warrant a crimp height adjustment. A shift after a jam would not indicate an adjustment, but a close evaluation of the tooling. A shift in the process between operators would not indicate an adjustment, but an evaluation of measurement capability. The idea of the control chart is to identify what caused the shift to justify if a adjustment to the process is warranted.

The FineAdjust applicator has extreme ease of adjustment. It is just as important to chart and document process control with the FineAdjust applicator.

If the process shift is due to a jam or a change in operators, more evaluation may be necessary than a adjustment.



For decades many crimping processes have been producing product within specification. Today with statistical process control, the philosophy of quality falling within specification is being replaced by achieving target with continuous reduction in variability. Control charting is a tool that truly allows a company to understand their process.

ATTENTION

Reference must always be made to product application / crimp specification to determine crimp parameters.

FineAdjust Applicator



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